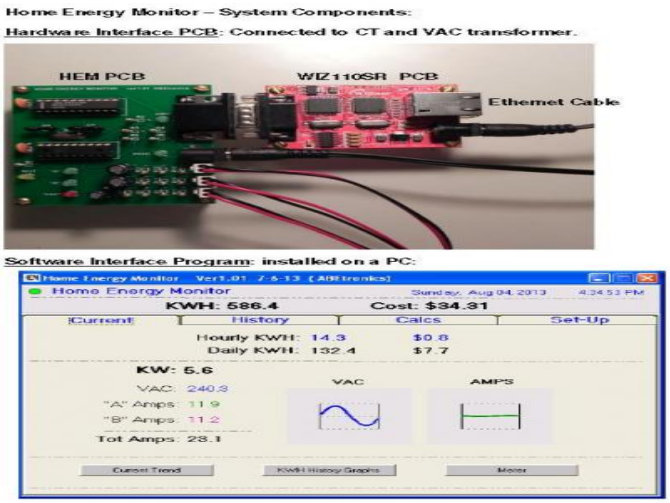
1-800-831-4242
www.Jameco.com
JAMECO ELECTRONICS

Home Energy Monitor

PART NO.



This project will allow the monitoring of AC voltage and current for an entire home. The data collected is then used in calculating Real Time KW usage, KHW, RMS AC Voltage and Current, and power factor.
Enter the cost per KW from your electric bill to check if the power company is accurately measuring your POWER USAGE! It's very interesting to visualize how appliances operate and can detect if one needs to be replaced or not working properly.
This is a great project to learn more about your power usage in the home and what appliances or people in you household that use the most electricity.

Time Required: 12 hours depending on experience

Experience Level: Intermediate

Required tools and parts:

Can use the custom PCB and only have to solder components to sensor board
or can use a protoboard and wire wrap components.

Also Will Need :
PIC16F88 firmware to operate sensor board.
PC software to interface with sensor board.
Soldering gun: 129040 Solder:94570
screw driver, wire cutters, pliers

If not using custom PCB, Wire Wrap items needed.
Wire Wrap Tool: 2150361 Wire Wrap wire: 22631,22665
18 pin WW socket: 94482 20 pin WW socket: 38632
Protoboard,2-7/16X4: 263207

Bill of Materials:

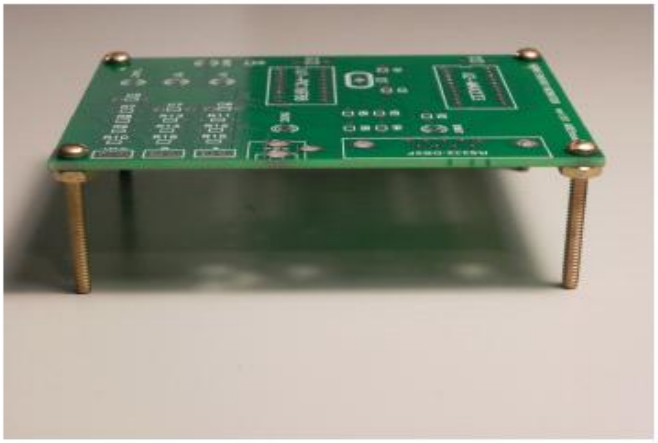
Qty	Jameco SKU	Component Name
1	2124322	U3:Serial to Ethernet Gateway Module
1	312733	U1:MCU 8-Bit PIC16F88
6	690620	R1-R6:100 ohm Resistor
1	106163	U2:RS-232 interface chip
2	151116	C1-C2:0.1uF Ceramic Disc Capacitor
3	29891	C5-C7:10uF Ceramic Disc Capacitor
2	15405	C3-C4:22pf 50 Volt Ceramic Disc Capacitor
5	691104	R9, R11-R14:10K ohm Resistor
2	691500	R7-R8:470K ohm Resistor
1	691340	R10:100K ohm Resistor
1	2006713	LED3:LED Uni-Color Red 635nm 2-Pin T-1
4	697629	LED2,LED4-LED6:Uni-Color Green
1	325068	X1:20MHz Crystal
1	1940740	PS1/2:5vdc Power Supply
Power supply for HEM PCB and Serial to Ethernet Gateway Module PCB.		
1	101258	PS3:12VAC power Supply
2		CT1,CT2: 0- 200 AMP CT
Non-invasive AC current sensor SCT-019 (200A max)		
3		2 pin cable/connector for CT/VAC

2-PIN CONNECTOR W/HEADER, .10"		
1	101179	PS2: PCB Plug
JACK,DC POWER,MALE,2.1mm,SOLDER EYELET TERMINALS,PC MOUNT		
2	690540	R15, R16: 47 OHM,1/4 WATT,5%
1	104978	CONNECTOR DSUB, RIGHT ANGLE, DB-9F
1	697688	LED1:Uni-Color Yellow
1		2.1MM COAX PLUG Y-ADAPTER, FEM - 2 MALE
Only use one 5vdc power supply		
1	65585	Socket IC 18 Pin
1	38623	Socket IC 20 Pin

Step 1 - PCB Mounting

Install 4 ea 4-40 x 1" bolts/nuts to support PCB off the table.

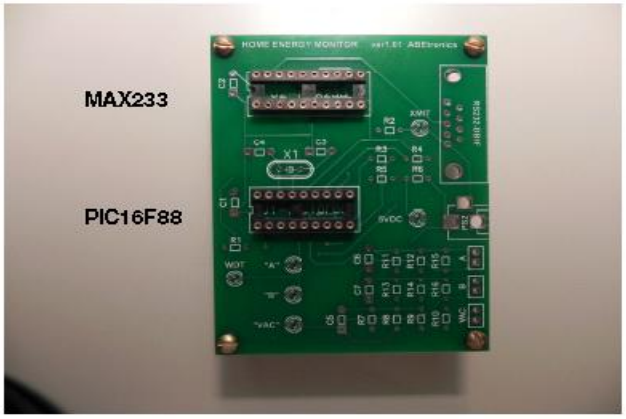
Install 4 ea 4-40 x 1" bolts/nuts to support PCB off the table.



Step 2 - U1/U2) chip sockets

Add 2 ea (U1/U2) chip sockets.
Place socket on PCB and solder into place.
Try not to hold soldering iron on board for more than 3 seconds.

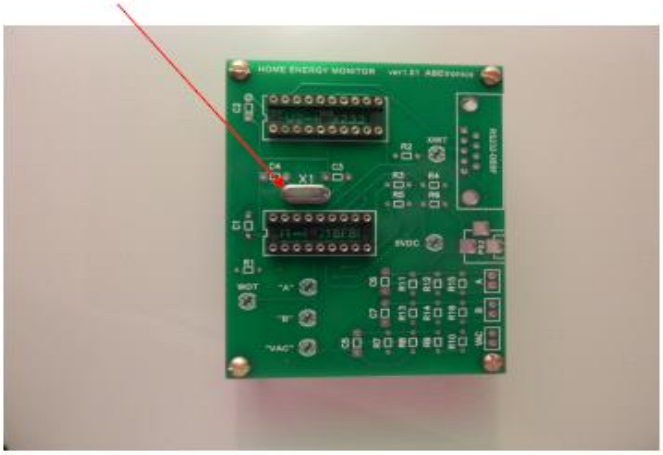
Step 1: Add 2 ea (U1/U2) chip sockets and solder to board.



Step 3 - (X1) 20MHz crystal

Add 1 ea (X1) 20MHz crystal and solder to board.

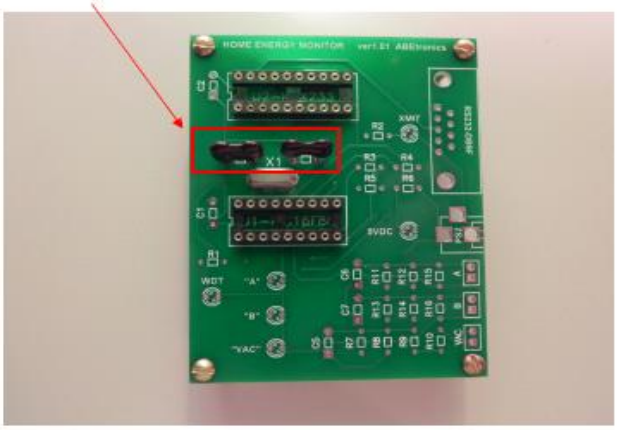
Step 3: Add 1 ea (X1) 20MHz crystal and solder to board.



Step 4 - (C3,C4) 22pF capacitors

Add 2 ea (C3,C4) 22pF capacitors and solder to board.

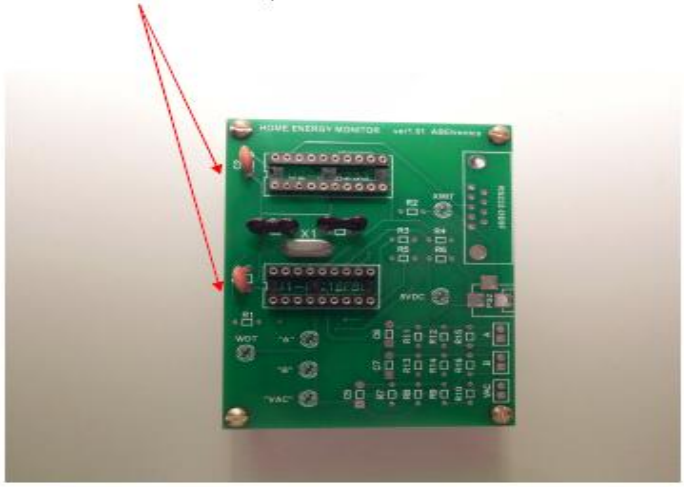
Step 4: Add 2 ea (C3,C4) 22pF capacitors and solder to board.



Step 5 - (C1, C2) 0.1uF Capacitors

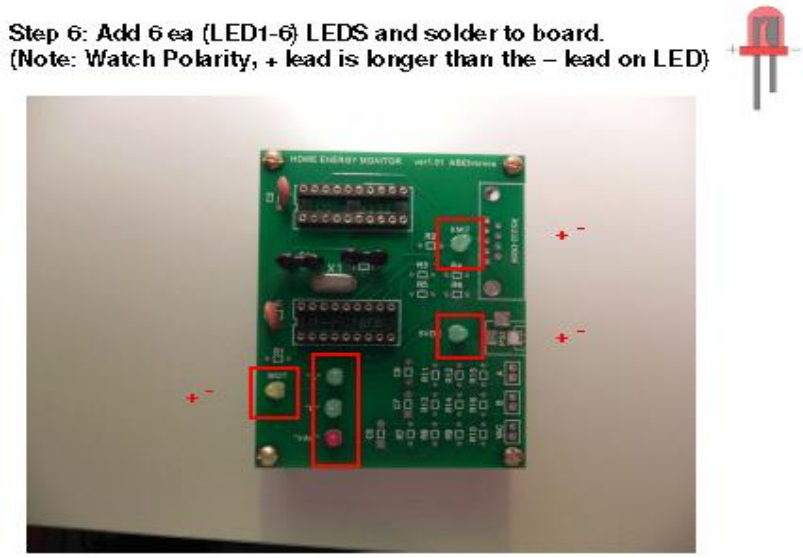
Add 2 ea (C1, C2) 0.1uF capacitors and solder to board.

Step 5: Add 2 ea (C1, C2) 0.1uF capacitors and solder to board.



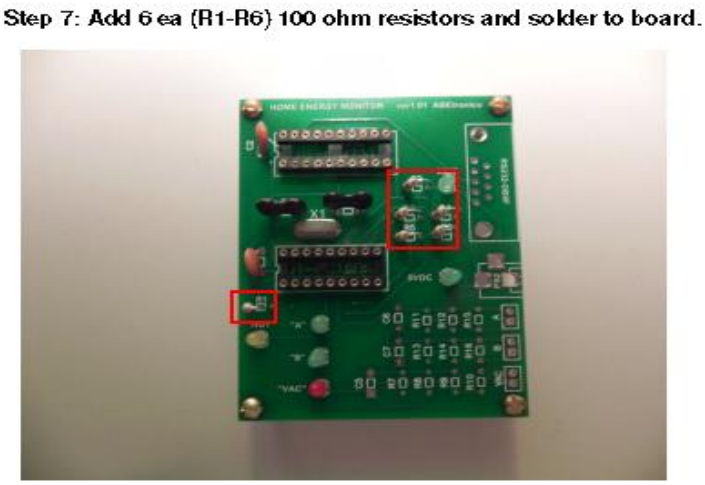
Step 6 - (LED1-6) LEDS

Add 6 ea (LED1-6) LEDS and solder to board.
(Note: Watch Polarity, + lead is longer than the - lead on LED)



Step 7 - (R1-R6) 100 ohm resistors

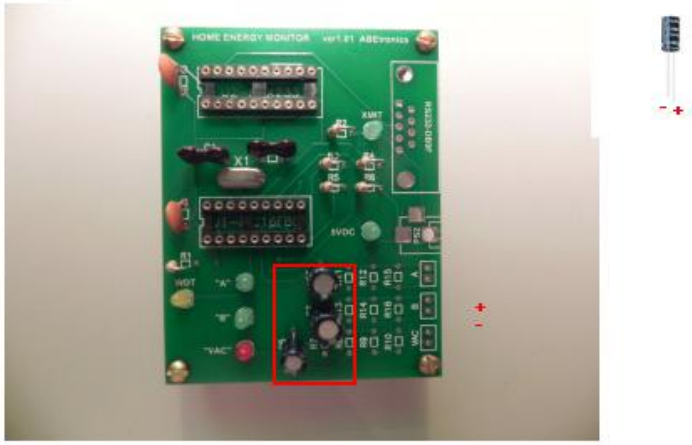
Add 6 ea (R1-R6) 100 ohm resistors and solder to board.



Step 8 - (C5-C7) 10uF Capacitors

Add 3 ea (C5-C7) 10uF capacitors and solder to board. (Watch Polarity)

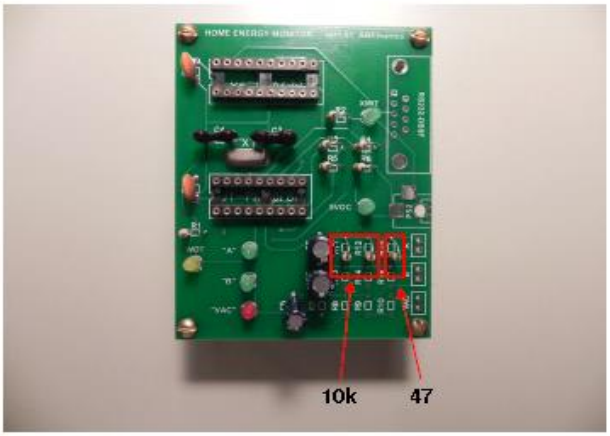
Step 8: Add 3 ea (C5-C7) 10uF capacitors and solder to board. (Watch Polarity)



Step 9 - Phase "A" Resistors

Add 2 ea (R11, R12) 10k ohm resistors, and 1 ea (R15) 47 ohm resistor. Solder to board.

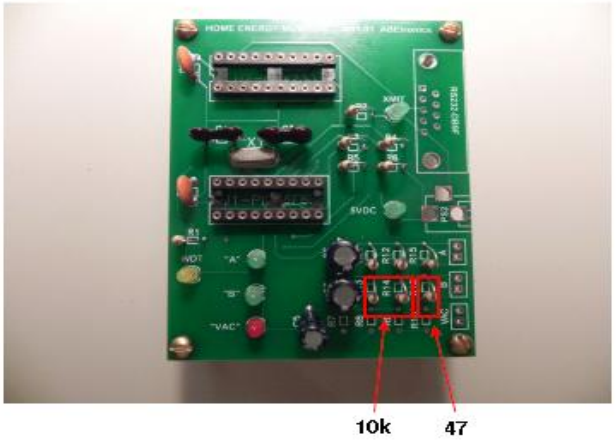
Step 9: Add 2 ea (R11, R12) 10k ohm resistors, and 1 ea (R15) 47 ohm resistor. Solder to board. (Phase "A")



Step 10 - Phase "B" Resistors

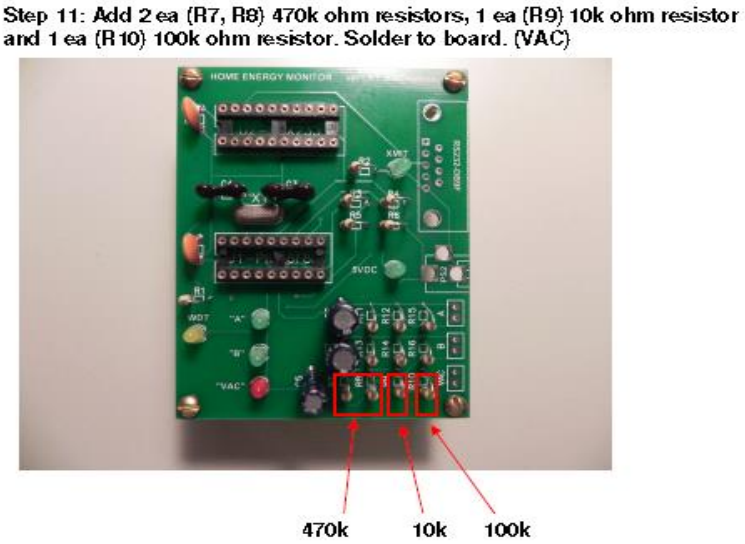
Add 2 ea (R13, R14) 10k ohm resistors, and 1 ea (R16) 47 ohm resistor. Solder to board.

Step 10: Add 2 ea (R13, R14) 10k ohm resistors, and 1 ea (R16) 47 ohm resistor. Solder to board. . (Phase "B")



Step 11 - "VAC" Resistors

Add 2 ea (R7, R8) 470k ohm resistors, 1 ea (R9) 10k ohm resistor and 1 ea (R10) 100k ohm resistor. Solder to board.



Step 12 - (PS2) Power Plug

Add 1 ea (PS2) Power Plug and solder to board.

Step 13 - (RS232-DB9F) DSUB connector

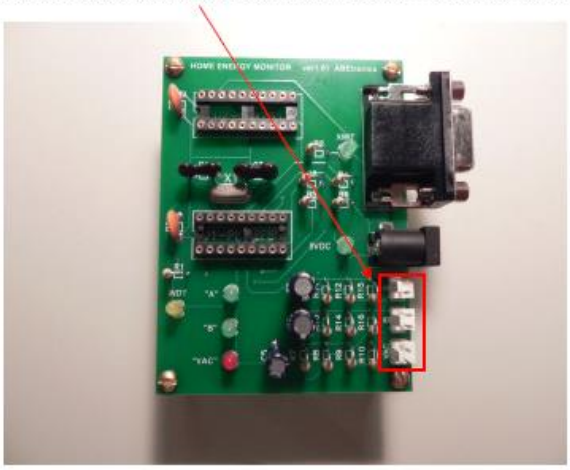
Add 1 ea (RS232-DB9F) DSUB connector and solder to board.

Step 13: Add 1 ea (RS232-DB9F) DSUB connector and solder to board.

Step 14 - (A, B, VAC) 2 pin cable connectors

Add 3 ea (A, B, VAC) 2 pin cable connectors and solder to board.

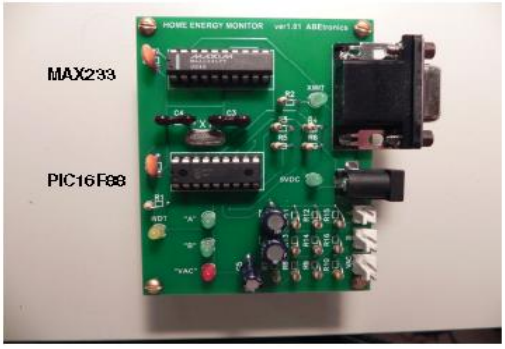
Step 14: Add 3 ea (A, B, VAC) 2 pin cable connectors and solder to board.



Step 15 - Insert chips into sockets* (see note)

Insert 1 ea MAX233 chip into U2 socket.
Insert 1 ea PIC16F88 chip into U1 socket. (*Note: need to program PIC16F88 chip before inserting into socket)
PCB component installation is now complete.

Step 15:
Insert 1 ea MAX233 chip into U2 socket.
Insert 1 ea PIC16F88 chip into U1 socket. (note: need to program PIC16F88 chip before inserting into socket)
PCB component installation complete!!



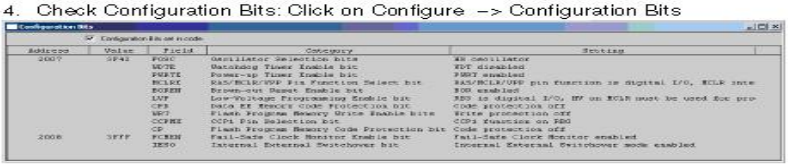
Step 16 - Program PIC16F88 chip then insert into U1 socket.

Need to program PIC16F88 chip before inserting into U1 socket.

8-1-13
Home Energy Monitor

Program PIC16F88 from Hex File Instructions:

1. Open MPLAB IDE v8.xx
2. Click on File –> New
3. Click on File –> Import... then select file: **EM.HEX**
4. Check Configuration Bits: Click on Configure –> Configuration Bits



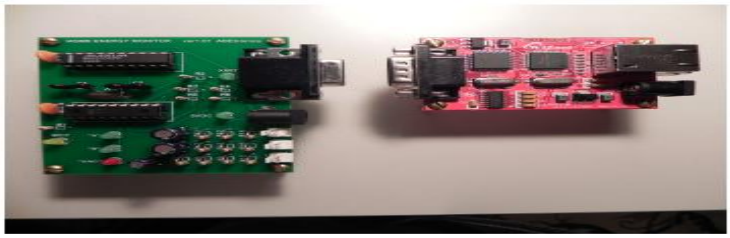
Address	Value	Field	Category	Setting
2007	3F41	FOSC	Oscillator Selection bits	HS Oscillator
		WDTE	Watchdog Timer Enable bit	WDT disabled
		PWRTE	Power-up Timer Enable bit	PWRT enabled
		MCLRE	RA5/MCLR/VPP Pin Function Select bit	RA5/MCLR/VPP pin function is digital I/O, MCLR inte
		BOREN	Brown-out Reset Enable bit	BOR enabled
		LVP	Low-Voltage Programming Enable bit	RB3 is digital I/O, HV on MCLR must be used for pro
		CPD	Data EE Memory Code Protection bit	Code protection off
		WRT	Flash Program Memory Write Enable bits	Write protection off
		CCPMX	CCP1 Pin Selection bit	CCP1 function on RB0
		CP	Flash Program Memory Code Protection bit	Code protection off
2008	3FFF	FCMEN	Fail-Safe Clock Monitor Enable bit	Fail-Safe Clock Monitor enabled
		IESO	Internal External Switchover bit	Internal External Switchover mode enabled

5. Put PIC16F88 chip into programmer.
6. Select Programmer.
7. Enable Programmer.
8. Select "Erase Flash Device"
9. Select "Program"
10. Remove PIC16F88 chip from Programmer.
11. **PIC16F88 chip is now programmed and ready to use. Insert into HEM PCB.**

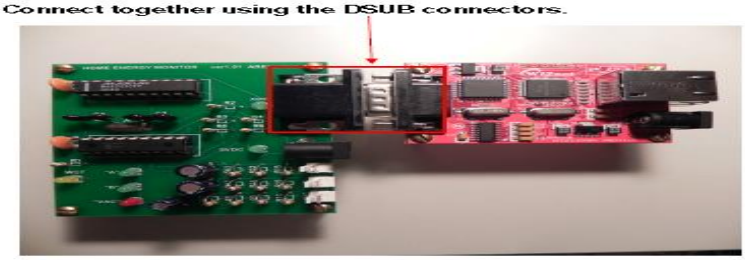
Step 17 - Connect HEM PCB and WIZ110SR PCB together

Completed HEM PCB and WIZ110SR PCB.
Now, connect together using the DSUB connectors.

Step 16:
Completed HEM PCB and WIZ110SR PCB.



Connect together using the DSUB connectors.

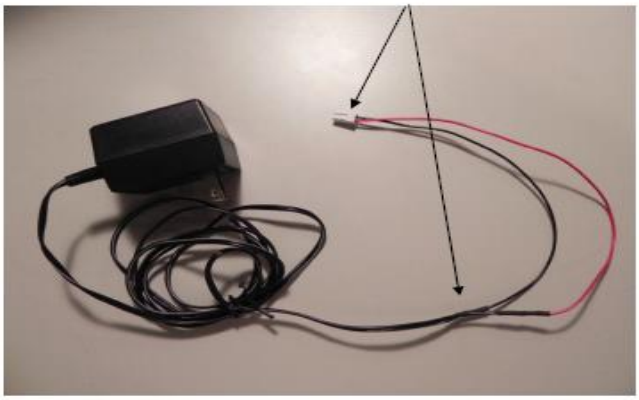


Step 18 - Attach 2 pin connectors

Cut off power supply plug, strip wires back and attach 2 pin connector.

Attach 2 pin connectors to phase "A" and "B" CTs cable ends.

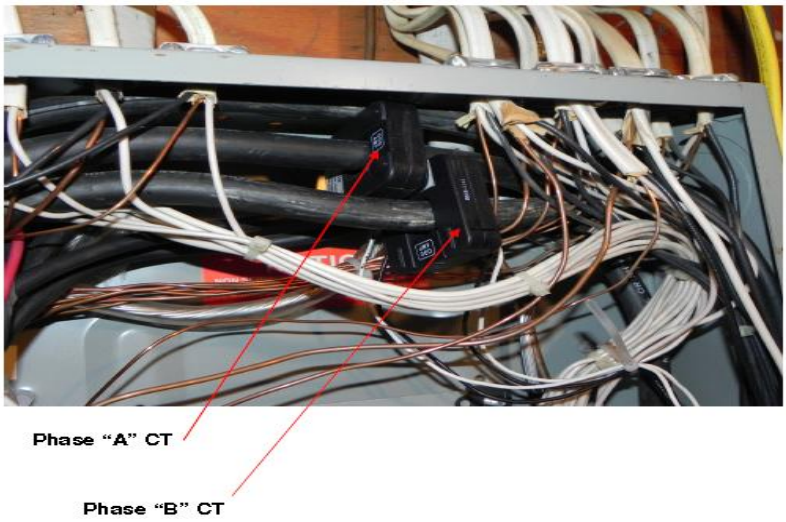
Step 17:
Cut off power supply plug and attach 2 pin connector.
Also attach 2 pin connectors to phase "A" and "B" CTs.



Step 19 - Install Current Transformers

Install the current transformers around incoming power wires.
Label one wire phase "A" and the other Phase "B".
WARNING:
Be Very Careful while working inside the energized load center.
Electrical shock can occur and could be deadly.
Proper electrical personal protective equipment must be worn.

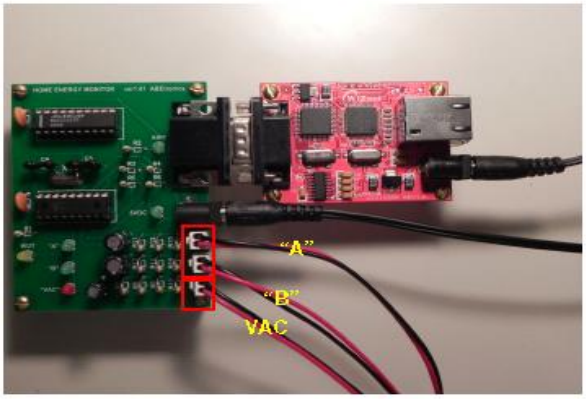
Current Transformers connected around incoming 120VAC power wires inside the load center.



Step 20 - Connect 2 pin signal connectors to HEM PCB

Plug the 2 pin VAC transformer cable into the VAC connector.
Plug the 2 pin CT cable for Phase "A" into the A connector.
Plug the 2 pin CT cable for Phase "B" into the B connector.

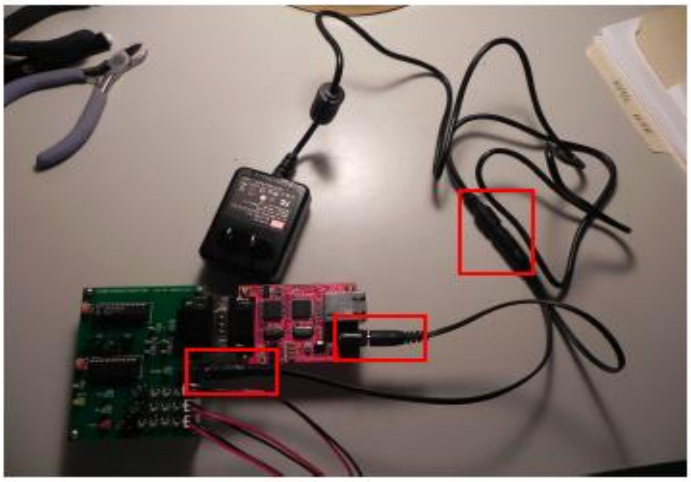
Step 18:
Connector phase "A" and "B" CTs to 2 pin connectors on HEM PCB.
Connector VAC transformer to 2 pin connector on HEM PCB.



Step 21 - Connect +5vdc power to HEM PCB and WIZ110SR PCB.

Connect +5vdc power to HEM PCB and WIZ110SR PCB.
Use 1 ea +5vdc power supply and 1 Y-adapter plug. Plug power supply into the female plug. Plug the other male plugs into the HEM and WIZ110SR PCBs.

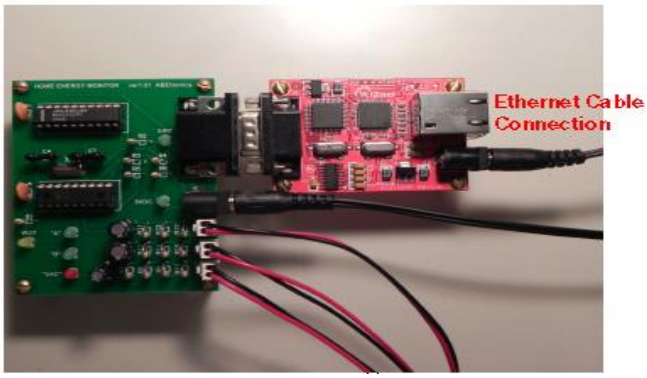
Step 19:
Connect +5vdc power to HEM PCB and WIZ110SR PCB.
Use 1 ea +5vdc power supply and 1 Y-adapter plug. Plug power supply into the female plug. Plug the other male plugs into the HEM and WIZ110SR PCBs.



Step 22 - Ethernet Cable Connections

Connect Ethernet cable into socket on the WIZ110SR PCB.
Connect other end to Ethernet hub/switch.
Home Energy Monitor interface install is now complete.

Step 20:
Connect Ethernet cable into socket on the WIZ110SR PCB.
Connect other end to Ethernet hub/switch.
Home Energy Monitor interface install is now complete.
Next need to install the HEM software on PC.



Step 23 - Power Up PCBs

Plug in VAC and +5vdc power supplies into 120VAC outlets.
+5vdc, VAC, A, B, LEDS should be on.
WDT and Data transmit LEDs should be turning on/off every 2 seconds.
If the VAC LED is not on, then check connections. Nothing will operate unless VAC signal is present.

Step 24 - Set-Up WIZ110SR PCB

Run the WIZ110SR configuration software.
Please contact sales@wiznet.co.kr in order to download the WIZVSP Installer.
See configuration manual for board set-up details.

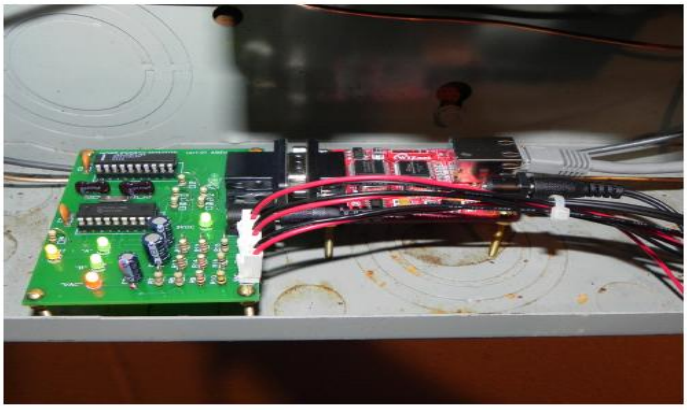
See set-up instructions for WIZ110SR (pages 13 to 15 of these instructions)

Step 25 - Mount PCBs

Home Energy Monitor PCB and WIZ110SR PCB can be mounted inside bottom of load center housing. Notice LEDS are "ON" when powered up.

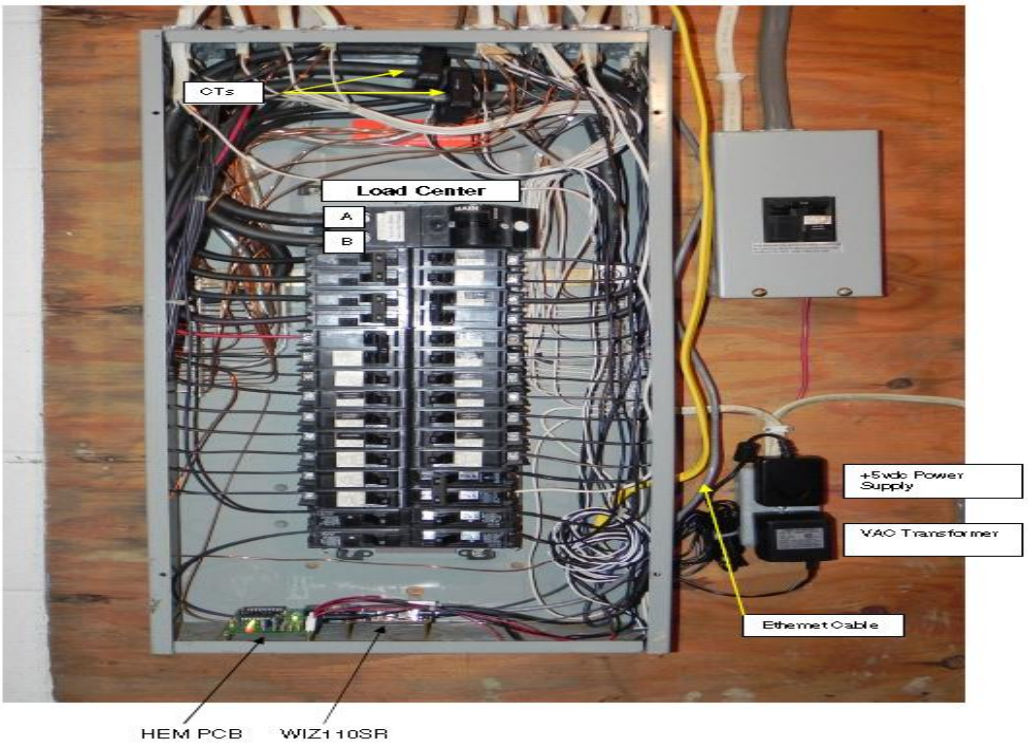
Home Energy Monitor PCB and WIZ110SR PCB mounted inside bottom of load center housing.

Notice LEDS are "ON" when powered up.



Step 26 - HEM hardware Interface in Load Center

Place both PCBs in bottom of load center housing.
Install CTs around incoming power wires and plug into HEM PCB.
Plug in VAC transformer into HEM PCB.
Plug in +5vdc into HEM and WIZ110SR PCBs.
Plug Ethernet cable into the WIZ110SR PCB.
Plug in the VAC transformer into AC outlet.
Plug in the +5vdc Power Supply into AC outlet.



Step 27 - Install the HEM software

Install the HEM software on a PC.
See User Manual for install and operating details.

Initial Set-Up Instructions for the WIZ110SR Board.

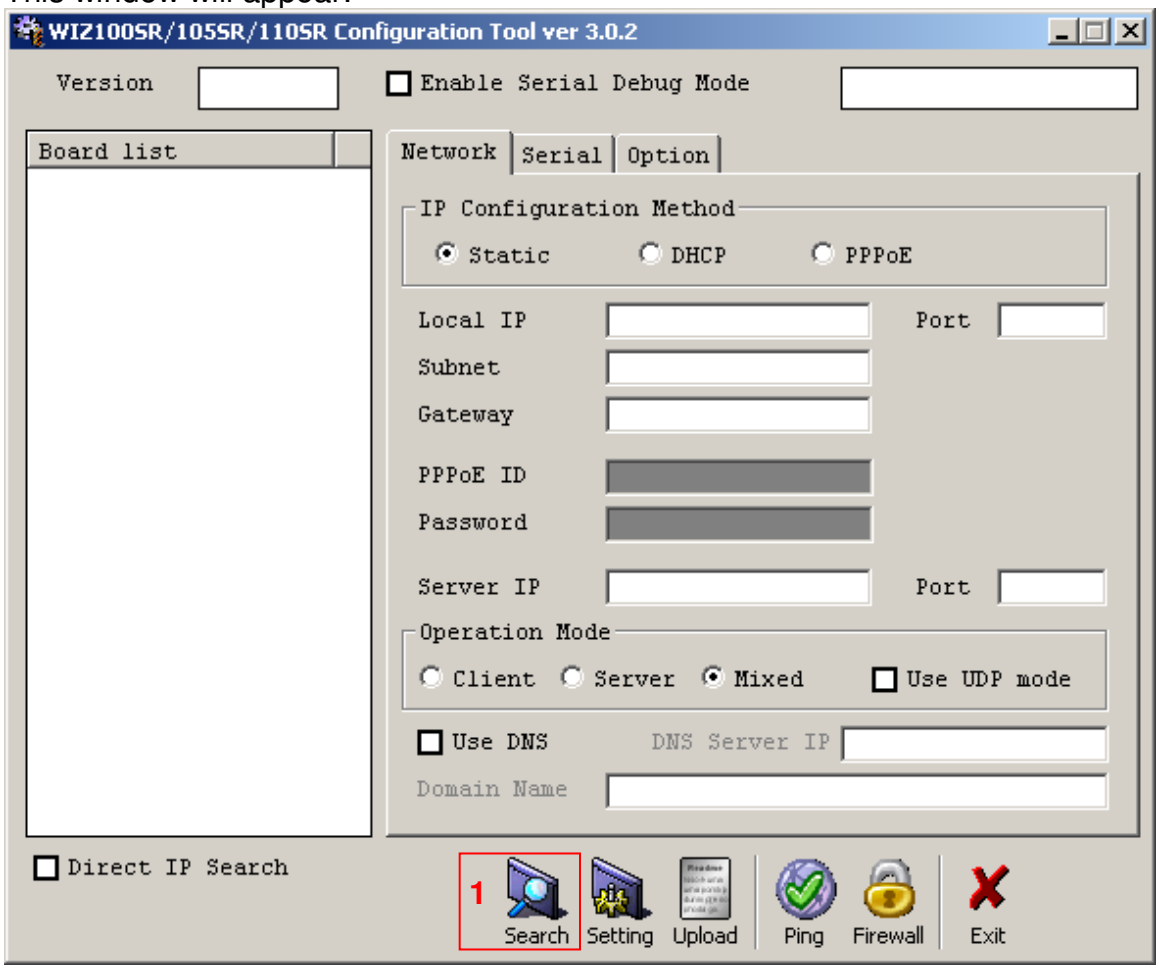
1. Connect WIZ110SR board to the Ethernet hub that is also connected to your computer. Use a LAN cable (RJ45 CAT-5 Ethernet cable)

2. Connect the 5vdc power supply to the board.

Run the "Configuration Tool" Software:

Launch WIZ1x0SR_105SR_CFG_V3_0_2.exe

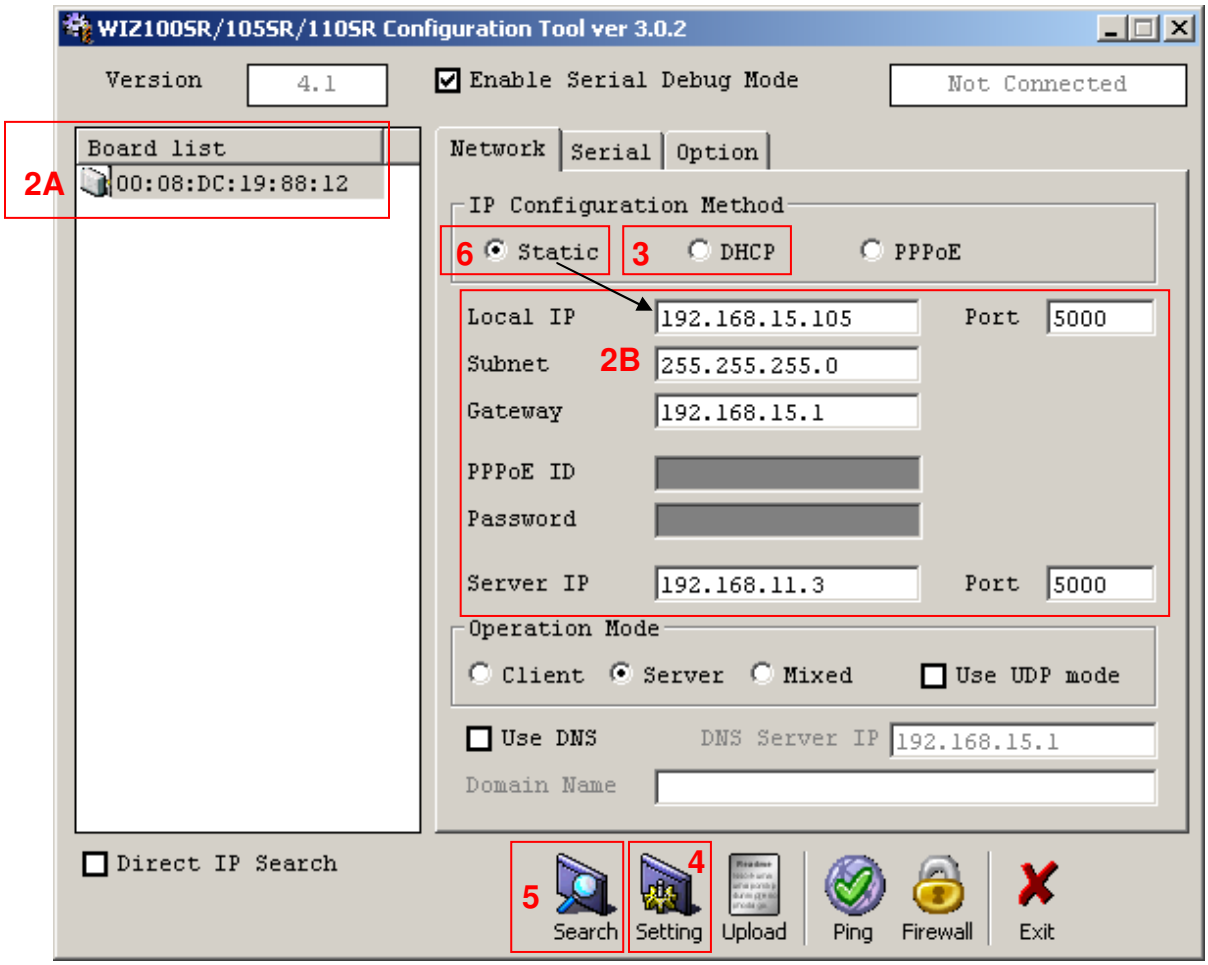
This window will appear:



1. Search for the WIZ110SR board. Click on the "**Search**" button.

Initial Set-Up Instructions for the WIZ110SR Board.

2. After the search is complete:
   A. The MAC address of the board will be listed in the board list to the left.
   B. The fields to the right will now contain network information.



3. To get an Local IP address assigned automatically, click on the "**DHCP**" option button.

4. Click on the "**Setting**" button, to send new set-up to WIZ110SR board.

5. Click on the "**Search**" button, to retrieve the new board set-up parameters.

6. To make sure that the Local IP address does not change, click on the "**Static**" option button and then repeat steps 4 and 5 above.

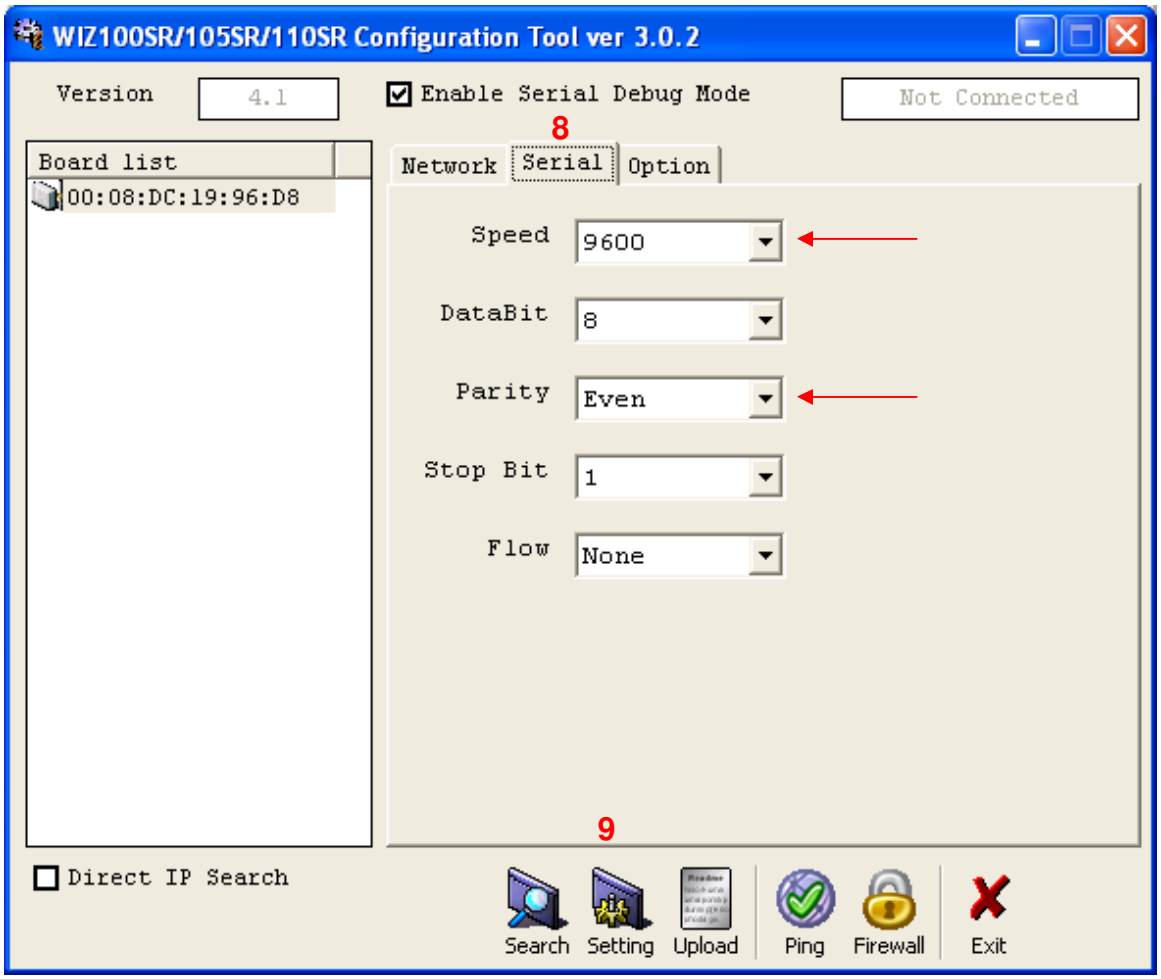
7. Enter IP address in the HEM software program under Set-Up tab.

Initial Set-Up Instructions for the WIZ110SR Board. (continued)

Set-Up Serial Interface:

8. Click on "**Serial**" Tab and make changes below:

Speed:	**9600** baud
Data Bits:	**8**
Parity:	**Even**
Stop Bit:	**1**
Flow:	**none**



9. Click on the "**Setting**" button, to send new set-up to WIZ110SR board.

10. Board Set-Up Complete.